

# Advanced Solid State Lighting for AES Deep Space Hab Project

Center Independent Research & Developments: KSC IRAD Program | Science Mission Directorate (SMD)



## ABSTRACT

The advanced Solid State Lighting (SSL) assemblies augmented 2nd generation modules under development for the Advanced Exploration Systems Deep Space Habitat in using color therapy to synchronize crew circadian rhythms. Current RGB LED technology does not produce sufficient brightness to adequately address general lighting in addition to color therapy. The intent is to address both through a mix of white and RGB LEDs designing for fully addressable alertness/relaxation levels as well as more dramatic circadian shifts.

## ANTICIPATED BENEFITS

### To NASA funded missions:

This project benefits the next generation of lighting for ISS. The SSLAs scheduled to launch in 2016 are only manually selectable. There is no simulated diurnal cycle to assist with circadian entrainment which may assist in alleviating some symptoms of isolation and help with crew sleep.

### To NASA unfunded & planned missions:

For long duration space flight beyond low earth orbit, sleep cycles and circadian entrainment must be optimized to keep crew functioning at peak efficiency. Similarly, crew must have as familiar an environment as possible to alleviate feeling of alienation. Lighting simulating a modified diurnal cycle, capable of using light therapy to facilitate crew day shifting and provide sleep therapy is required.

### To other government agencies:

This technology has benefits to assist with any agency using shift workers. It has the potential to augment alertness by suppressing melatonin production.

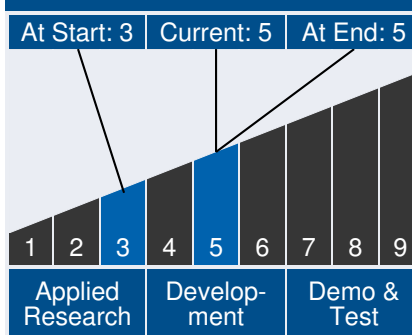


Augmented 2nd generation Custom Commercial Solid State Lighting Assembly for

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## Technology Maturity



## Management Team

### Program Director:

- Burton Summerfield

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## To the commercial space industry:

Any commercial space partner interested in long term habitation of space will need to assure the efficacy of crew and have a desire to ensure sufficient restful sleep.

## To the nation:

This project could be of benefit to shift workers, those living in the polar regions, or those with sleep disorders. The ability to regulate sleep using the bodies own mechanisms should help with overall health and alertness of the population

## DETAILED DESCRIPTION

Advanced solid state lighting assemblies were built for inclusion in the Advanced Exploration Systems ISS-derived Deep Space Habitat concept demonstrator. The augmented second generation assemblies were modified versions of the first generation custom commercial lighting, using the same form factor, power supply, and balanced white light LED components. This effort replaced the manual adjustments with an interface to the Deep Space Habitat (DSH) Concept Demonstrator avionics allowing full control of the general purpose white lights to simulate a full terrestrial day. Modifications allowed additional RGB lighting to be added to the existing fixtures and accessed through the same avionics. Circadian synchronization can be addressed on an as needed basis, obviating crew stress of non-white light dominance. The completed lights were then installed in the concept demonstrator at Marshall Space Flight Center. They were part of the ISS-derived DSH concept assessment.

These lights were then evaluated by Dr. Phil Sloane of UNC-Chapel Hill and Dr. Mariana Figuero of the Lighting Research Center at RPI. The team at LRC/RPI made measurements and

## Management Team (cont.)

### Program Executive:

- Karen Thompson

### Program Manager:

- Nancy Zeitlin

### Project Manager:

- Pamela Mullenix

### Principal Investigator:

- Eirik Holbert

## Technology Areas

### Primary Technology Area:

Human Health & Performance (TA 6.3)

### Other Technology Areas:

- Long-Duration Health (TA 6.3.2)
- Behavioral Health & Performance (TA 6.3.3)

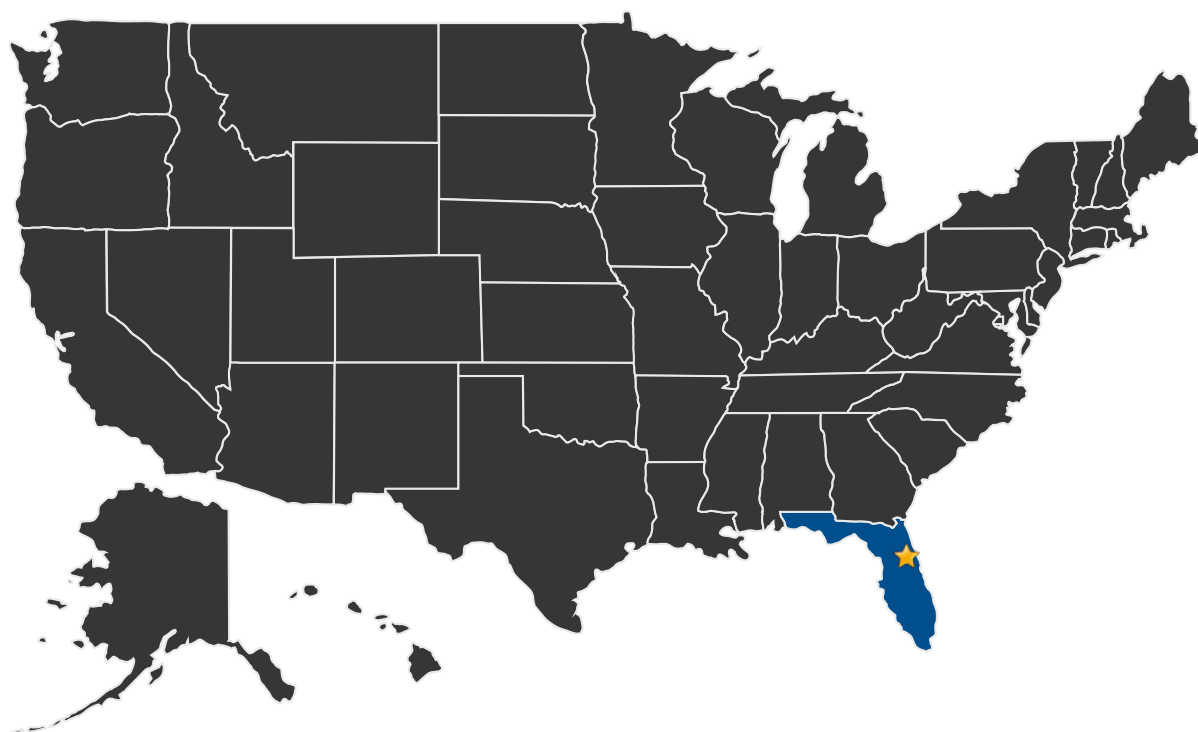
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the joint UNC/RPI team provided a subjective assessment based on their expertise with sleep disorders and light therapy.

## U.S. LOCATIONS WORKING ON THIS PROJECT



■ U.S. States With Work

★ **Lead Center:**  
Kennedy Space Center

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## DETAILS FOR TECHNOLOGY 1

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### Technology Title

Advanced Solid State Lighting

### Technology Description

This technology is categorized as a hardware assembly for manned spaceflight

Solid state lighting which mimics within mission parameters a diurnal cycle. Brightening and introducing more blue light as time approaches crew work shift, dimming and reddening as the crew approaches recreation and sleep shifts. This light could be programmed to assist with shifting crew sleep schedules and managing sleep disorders.

### Capabilities Provided

Provides the capability to maintain a normal circadian adjustment without jarring transitions of brightness or color.

### Potential Applications

This technology is applicable to the sleep disorder community. Potential users could be those who are not exposed to a normal diurnal period including those in medical communities, shift workers, and those near or above the arctic circles.